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Experimental Investigations on Cement Concrete by Using Different Steel Waste as a Fibre to Strengthen the M30 Concrete

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***Abstract**: As the human going to grow in technology enhances not only human comforts but also damages the environment. Use of metals as containers has become popular and safe now, especially to carry the liquids. Inspite of the inherent advantages and disadvantages existent in its disposal. Today the construction industry is in need of finding cost effective materials for increasing the strength of concrete structures. Hence an attempt has been made in the present investigations to study the influence of addition of waste materials like lathe waste, soft drink bottle caps, empty waste tin, waste steel powder from workshop at a dosage of approximate 0 To 1.6% of total weight of concrete as a fiber. The lathe waste, empty tins, soft drink bottle cops were deformed into the rectangular strips of 15mm to 25mm in size.*

Green building is an increasingly important global concern and a critical way to conserve natural resources and reduce the amount of materials going to our landfills. Large quantities of metal waste are generated from empty metal cans and bottle caps of juices and soft drinks. This is an environmental issue as metal waste is difficult to biodegrade and involves processes either to recycle or reuse. In this investigation, a comparison have been made between plain cement concrete and the fiber reinforced concrete containing lathe scrap (steel scrap)in various proportions by weight. The fiber used is irregular in shape and with varying aspect ratio. The 28 days strength of WSFRC for compressive strength, tensile strength and flexural strength is found to be increased when compared with the 28 days strength of plain cement concrete.

Experimental investigation has been do by using M30 mix and tests has carried out as per recommended procedure by with conventional concrete has been gain more tensile strength as well as compressive strength .concrete is weak in tensile strength and strong in compression so while we improve the tensile strength.

***Key Words:** Fibre, Steel waste, lathe waste, bottle caps, cans, Compressive Strength, Split tensile Strength, flexural Strength*

1. INTRODUCTION

Today, the world is facing the construction of very challenging and difficult civil engineering structures. Concrete, being the most important and widely used material, is called upon to possess very high strength and sufficient workability properties and efforts are made in the field of concrete technology to develop the properties of concrete by using fibres and other admixture in the concrete up to certain proportions. In the view of the global sustainable developments, it is imperative that Waste Steel Fiber Reinforced Concrete (SWFRC) provide improvements in the tensile strength, toughness, ductility, post cracking resistance, fatigue characteristics, durability, shrinkage characteristics, impact, cavitations, erosion resistance and serviceability of concrete. Due to these benefits, the use of SWFRC has increased during last two decades. In each lathe industries wastes are available in form of steel scraps are yield by the lathe machines in process of finishing of different machines parts and dumping of these wastes in the barren soil contaminating the soil and ground water that builds an unhealthy environment. Now a day’s these steel scraps as a waste products used by innovative construction industry and also in transportation and highway industry. In addition to get sustainable progress and environmental remuneration, lathe scrap as worn-recycle fibers with concrete are likely to be used. When the steel scrap reinforced in concrete it acquire a term, fiber reinforced concrete. Concrete in general is weak in tensile strength and strong in compressive strength. The main aim of researchers or concrete technologists is to improve the tensile strength of concrete. To overcome this serious defect, partial incorporation of fibers is practiced. Great quantities of steel waste fibers are generated from industries related to lathes, empty beverage metal cans and soft drink bottle caps. This is an environmental issue as steel waste fibers are difficult to biodegrade and involves processes either to recycle or reuse. Fiber reinforced concrete is an interesting topic discussed by numerous researchers in the last two decade. Concrete has an extensive role to play in the construction and improvement of our civil engineering and infrastructure development. Its great strength, durability and veracity are the properties that are utilized in construction of Roads, Bridges, Airports, Railways, and Tunnels, Port, Harbours, and many other infrastructural project. Use of admixtures to concrete has long been practised since 1900. In the early 1900s, asbestos fibres were used in concrete. There was a need to find replacement for the asbestos used in concrete. By the 1960s, steel, glass (GFRC) and synthetic fibres such as polypropylene fibres were used in concrete. Great quantities of steel waste fibers are generated from industries related to lathes, empty beverage metal cans and soft drink bottle caps. This is an environmental issue as steel waste fibres are difficult to biodegrade and involves processes either to recycle or reuse. The resulting compressive strength, split tensile strength and flexural strength of the mixture depends on the type of cement, size and type of aggregate, period and type of curing adopted. Admixtures is defined as a material, other than cement, water and aggregate, that is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Chemical admixture and Mineral admixture.

In this investigation mineral admixture are the metallic waste obtained from varies sources such as mild steel lathe waste, empty beverage tins, soft drink bottle caps are deformed into the rectangular from with an approximate size of 10mm to 15mm as in the form of fibers. These fibers are added in the concrete with 0.4%, 0.8%, 1.2%and 1.6% by weight of concrete. Ordinary Portland Cement (OPC) 43 grade and fine aggregate with less amount of clay and silt with sand size is passing through 1.19mm sieve and retained on 900micron sieve. The coarse aggregate used in 20mm & 10mm size. It is well graded and potable water, free from impurities such as oil, alkalies, acids, salts, sugar, and organic materials were used.

(a)

(b)

(c)

(d)

Fig No.1 Different types of steel waste

2. MATERIALS AND THEIR PROPERTIES

A. Cement

Ordinary Portland cement of 43 grade is used throughout the experimental program. The standard consistency is 34% where as the initial and final setting time is 36 min. and 284 min. respectively. The specific gravity of cement is 2.99 and its compressive strength after 28 days is found to be 47.50 Mps.

Table 2.1 Characteristics Properties of Cement

Sr. No.	Characteristics	Experimental value	Specified value as per IS:8112-1989
1	Consistency of cement (%)	34%	---
2	Specific gravity	2.99	3.15
3	Initial setting time (minutes)	36	>30 As Per IS 4031-1968
4	Final setting time (minutes)	284	<600 As per IS 4031-1968
5	Compressive strength (N/mm^2) (i) 3 days (ii) 7 days (iii)28days	 25.77 40.42 47.50	 >23 >33 >43
6	Soundness (mm)	1.00	10
7	Fineness of Cement	5%	10% As Per IS 269-1976.

B. Coarse Aggregate: Coarse aggregate of maximum size 20 mm is used throughout the concrete. The specific gravity is tested by using the pycnometer bottle is found 2.87 and fineness modulus of 20mm aggregates is 2.64.

C. Fine Aggregate: Fine aggregate used for this experimental study for concrete is river sand conforming to zone-II. The specific gravity of fine aggregate is 2.65.

D. Water: The water used in the concreting work as well as curing purpose was the potable water which is free from impurities.

Table 2.2 Physical Properties of Aggregates

Sr.No.	Specific Gravity of Fine Aggregates	2.65
1	Specific Gravity of Coarse Aggregates	2.87
2	Free Moisture Content	2%
3	Water Absorption	1.82%

3. EXPERIMENTAL INVESTIGATION

3.1 Casting of specimen

Standard cubical moulds of size 150mm× 150mm× 150mm and cylinder mould of depth 150mm ,height 300mm and diameter of 100mm and beam mould of 150mm×150mm×700mm made of cast iron were used to cast concrete specimens to test compressive strength ,split tensile strength and flexural strength respectively. The quantities of cement, fine aggregates, coarse aggregates, and water for each batch were weighted to an accuracy of 1kg separately. Sand and steel waste is added to this mixture in dry form. Finally, coarse aggregates were added and thoroughly mixed to get a uniform mixture throughout the batch. Required dosage of water was added in the course of mixing. Through mixing was done until concrete appeared to be homogeneous and of desired consistency. Concrete mix so prepared was tested for slump flow and reading of slump carefully recorded. The inner surfaces of moulds were oiled so as to avoid the sticking of concrete. Concrete was then filled in previously prepared moulds with controlled vibration to the concrete. Surface of concrete was finished level using a trowel and date along with batch number was marked properly on it. Finished specimens were left to harden and removed from moulds approximate after 24 hours of casting. They were then placed in water tank containing portable water and were left for curing.

Fig No.2: Steel Waste Fibre added Concrete

Table -3.1: Compressive, Split tensile and Flexural strength of waste steel fiber added concrete

Sr.No.	%of waste steel	No. of cubes	No. of cylinder	No. of beam
1	0	6	6	6
2	0.4	6	6	6
3	0.8	6	6	6
4	1.2	6	6	6
5	1.6	6	6	6

3.2 TESTING OF CONCRETE

The test was conducted on cubes according to IS code 516-1959. Specimens were taken out from curing tank at the age of 7 and 28 days of moist curing and were then tested. Specimens were tested on 200 tones capacity of universal testing machine (UTM). The compression and tensile strength tested on UTM and flexural strength test of flexural strength testing machine.

Fig. No. 3: Testing of samples

Table -3.2: Compressive Strength by adding waste steel fibre

Sr. No.	% of waste steel	Compressive Strength at 7 days	Compressive Strength at 28 days
1	0	22.88	38.29
2	0.4	23.25	38.88
3	0.8	23.92	39.36
4	1.2	24.52	39.90
5	1.6	24.88	40.85

Table -3.3: Split Tensile Strength by adding waste steel fibre

Sr.No.	% of waste steel	Split Tensile Strength at 7 days	Split Tensile Strength at 28 days
1	0	1.71	2.92
2	0.4	1.92	3.12
3	0.8	2.10	3.36
4	1.2	2.26	3.54
5	1.6	2.34	3.76

Table -3.4: Flexural Strength by adding waste steel fibre

Sr. No.	% of waste steel	Flexural Strength at 7 days	Flexural Strength at 28 days
1	0	3.42	5.38
2	0.4	3.65	5.60
3	0.8	3.88	5.83
4	1.2	4.03	6.01
5	1.6	4.17	6.09

4.0 INTERPRETATION OF TEST RESULTS

4.1 Compressive Strength

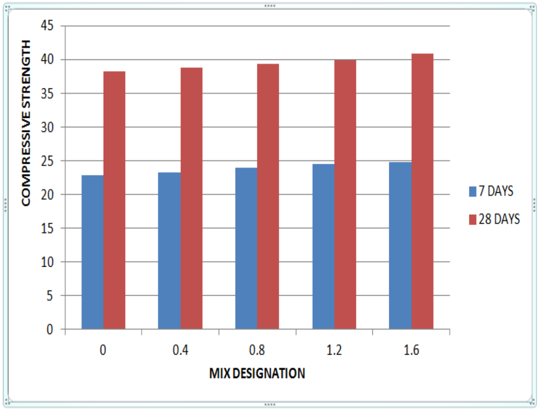

Fig. No. 4 : Graph comparing compressive strength for 7 and 28 days

It can be seen from the above tables and figures the addition of waste steel fibre increase in compressive strength of concrete both at the curing age of 7 days and 28 days. The percentage increase in strength of concrete at 28 days after adding 0.4, 0.8, 1.2 and 1.6 percentage waste steel fibre is 1.54%, 2.79%, 4.20% and 6.68% respectively. However the better compressive strength of the mixes was found to be comparable to the control mix containing no WSFRC.

4.2 Split Tensile Strength

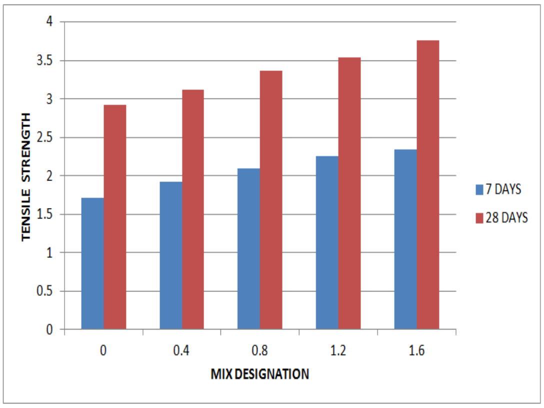

Fig. No. 4: Graph comparing Split Tensile Strength for 7 and 28 days

It can be seen from the above tables and figures that the split tensile strength of the mixes containing of waste steel fibre are higher as compared to the control mix. It can be seen from the above tables and figures the addition of waste steel fibre increase in tensile strength of concrete both at the curing age of 7 days and 28 days. The percentage increase in strength of concrete at 28 days after adding 0.4, 0.8, 1.2 and 1.6 percentage waste steel fibre is 6.84%, 15.06%, 21.23% and 28.76% respectively. However a good tensile strength of the mixes was found to be comparable to the control mix containing no WSFRC.

4.3 Flexure Strength

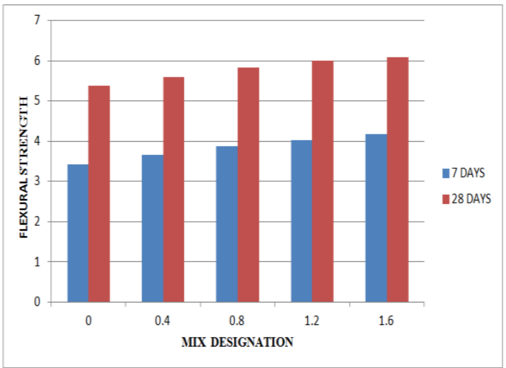

Fig. No. 5: Graph comparing Flexural Strength for 7 and 28 days

It can be seen from the above tables and figures that the flexural strength of concrete mixes containing waste steel fibre are higher than the flexural strength of the control mix. The percentage increase in flexural strength of concrete at 28 days after adding 0.4, 0.8, 1.2 and 1.6 percentage of waste steel fibre is 4.08%, 8.36%, 11.76% and 13.19% respectively. However the a better strength of the mixes was found to be comparable to the control mix containing no WSFRC. This trend is similar to the trends obtained for compressive strength and split tensile strength and the reason for the same is as already explained.

4. CONCLUSIONS

Based on the results obtained in the present investigation, the following conclusion can be drawn-

a) The results obtained in the present study indicates that it is feasible to add the steel waste as a fibre for improving the strength characteristics of concrete, thus the WSF can be used as an additive material for the production of concrete to address the waste disposal problems and to maximize the strength of concrete with usages of WSF which is most cheaply available.
b) With the addition of the waste steel fibre
c) Addition of waste steel fibres helps in increasing ductility of concrete.
d) Addition of waste steel fibres in high strength concrete adds more advantage compared to its addition in normal strength concrete. High strength concrete has a compact structure, low water cement ratio. As the temperature increases more internal stresses are induced causing bursting or explosive spalling. Waste steel fibres helps in decreasing the internal pressures and also helps in improved flexural and split strengths.
e) The geometry of waste steel fibres helps in better bonding of concrete, it also helps the fibres to act more efficiently as a bridge in reducing the fracture of concrete. It also helps us in attaining fibre free surface.
f) Fiber addition improves ductility of concrete & its post-cracking load carrying capacity.
g) Increases the cube compressive strength of concrete in 7 days to an extent of 8.74%
h) The increase in the various mechanical properties of the concrete mixes with polythene fiber is not in same league as that of the steel fiber.
i) Increases the cube compressive strength of concrete in 28 days to an extent of 6.68% at the dosage of 1.6% of addition of waste steel fibre.
j) Increases the split tensile strength of concrete in 28 days up to 28.76 % at the 1.6% of fibre addition. It is much higher strength increment at last specimen in our study .it shows that as per our objective we can gain better tensile strength.
k) In this the flexural strength of concrete at 1.6% of waste steel fibre addition in concrete at 28 days at a percentage of 13.19.

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